

CLAIMS

WE CLAIM AS OUR INVENTION:

1. A ceramic thermal barrier coating comprising a region of features having a
5 size range of less than 200 nm.

2. The ceramic thermal barrier coating of claim 1, further comprising:

a layer of MCrAlY bond coat disposed over a substrate;

a layer of thermally grown oxide disposed on the MCrAlY bond coat;

10 a layer of ceramic oxide insulating material disposed over the thermally grown
oxide layer; and

wherein the region of nano-sized features comprises a mixed oxide layer formed
of mixed oxide particles having a size range of less than 100 nm disposed between the
thermally grown oxide layer and the layer of ceramic oxide insulating material.

15 3. The ceramic thermal barrier coating of claim 2, wherein the size range is
less than 50 nm.

20 4. The ceramic thermal barrier coating of claim 2, wherein the size range is
between 10-100 nm.

5. The ceramic thermal barrier coating of claim 2, wherein a ratio of average
thickness of the mixed oxide layer to average thickness of the thermally grown oxide
layer is between 0.333 and 0.1667.

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6. The ceramic thermal barrier coating of claim 1, further comprising:
a layer of MCrAlY bond coat disposed over a substrate;
a layer of thermally grown oxide disposed on the MCrAlY bond coat;
a layer of ceramic oxide insulating material disposed over the thermally grown

5 oxide layer; and

wherein the region of nano-sized features comprises a plurality of alumina
projections extending across the interface from the mixed oxide layer into the insulating
material layer and having a cross-sectional lineal density of between 1 and 10
projections per 200 nm.

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7. The ceramic thermal barrier coating of claim 6, wherein of the projections
comprise an aspect ratio of between 5 and 50.

8. The ceramic thermal barrier coating of claim 1, wherein the nano sized
15 features comprise columnar grains having cross-sectional widths in the range of 1-5 nm
formed within individual splats of a ceramic insulating material deposited by an air
plasma spray process.

9. The ceramic thermal barrier coating of claim 1, further comprising:
20 primary columnar grains extending transversely relative to a substrate surface;
and

wherein the nano-sized features comprise secondary columnar grains extending
laterally from the primary columnar grains and having lengths in the range of 5-80 nm.

25 10. The ceramic thermal barrier coating of claim 9, further comprising the
secondary columnar grains having an as-deposited tip with a radius of curvature of less
than 0.1 nm.

11. A ceramic thermal barrier material comprising a region of features maintaining a Specific Surface Area of at least $20,000 \text{ cm}^2/\text{cm}^3$ after exposure of the material to a temperature of $1,200^\circ\text{C}$ for 1,000 hours.

5 12. A method of predicting the performance of a ceramic thermal barrier coating, the method comprising:

constructing a database correlating data indicative of performance of a plurality of coating materials in high temperature environments with data indicative of a degree of nano-sized features in the respective coating materials;

10 obtaining data indicative of a degree of nano-sized features in a sample coating; and

using the database to predict performance of the sample coating in a high temperature environment based on the data indicative of the degree of nano-sized features in the sample coating.

15 13. The method of claim 12, wherein the data indicative of a degree of nano-sized features comprises Specific Surface Area values.